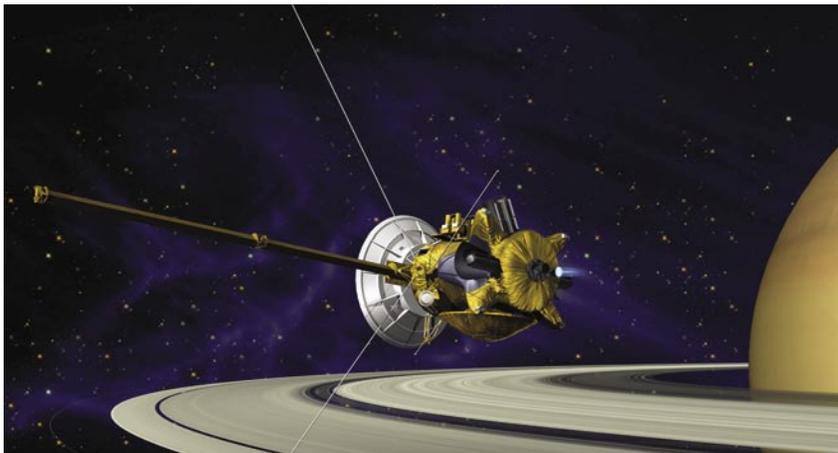
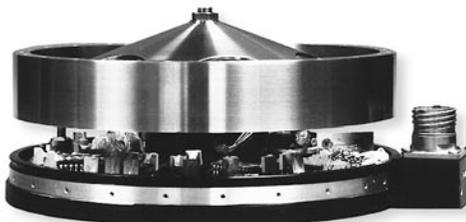




A Small, High-Torque Reaction/Momentum Wheel

...for small satellites, spacecraft attitude control, and stability



NASA Goddard Space Flight Center invites companies to license its unique reaction/momentum wheel design. The design is small and low weight and features extremely low residual imbalance and large, highly controllable torque. The technology helps significantly lower the risks and financial investments normally associated with introducing a new spacecraft component. This innovation has received NASA's Government Invention of the Year Award.

Benefits

- **High torque:** Offers a high level of torque within a small package
- **Low power:** Can achieve high level of torque using only 60 watts
- **Low cost:** Enables satellite manufacturers to build the device in house through a simple design and low parts count
- **Low residual imbalance:** Improves satellite stability and reduces pointing jitter by statically and dynamically balancing the entire rotating system after assembly
- **Adaptable:** Can be easily changed to meet specific mission requirements
- **Small:** Encloses the flywheel, motor, sensors, and mounting provisions for electronics in a small housing
- **Proven:** Has flown aboard several space missions

Applications

Originally developed for NASA's Small Explorer (SMEX) program—an initiative to develop highly focused and relatively inexpensive scientific spacecraft—the reaction/momentum wheel design offers specifications ideal for other small spacecraft.

- Small spacecraft
 - Satellites
 - Attitude control
 - Stability

Technology Details

How it works

NASA Goddard's reaction/momentum wheel consists of a motor-driven flywheel placed at one end of a shaft supported by at least two bearings. The motor, flywheel, and shaft all use the same spin axis. The flywheel is cantilevered off the end of the motor shaft, enabling the entire rotating assembly to be balanced to an extremely high degree of accuracy. The wheel can be operated with a current (torque) or speed (momentum) controller. Although mounting provisions for electronics exist inside the housing, the wheel normally uses external drivers.

Pressure and temperature can be monitored in the wheel housing. Diester grease eliminates the need for lubrication reservoirs and the shelf-life storage concerns associated with fluid lubricants.

When the motor receives input power, the output shaft rotates, which causes the flywheel to rotate. The rotating flywheel stores momentum; when accelerated or decelerated, a resultant torque is created. An equal, opposite reaction torque is created on the satellite, causing it to change attitude. By employing three or more wheels with spin axes in at least three directions and controlling the magnitude of the torque produced by each flywheel, the satellite attitude and instrument aim can be changed and maneuvered.

Why it is better

NASA Goddard's wheel design creates a very high torque compared to its relatively small

size and weight. This enables faster satellite reaction and maneuvering, improving the utility of the satellite itself. With a lighter weight, the wheel costs less to be put into orbit, enabling lighter satellites to be placed into higher orbits, and enabling faster maneuvering than heavier designs.

The design also ensures that the entire rotating system is balanced, minimizing dynamic unbalance forces in all rotating parts, which can cause noise in the satellite output signal. Because unbalance forces add to the load carried by the bearings, this may prolong bearing life.

Further, NASA Goddard's technology helps to minimize drag torque, reducing the amount of power needed to achieve a particular rate of speed or acceleration. Using less power is important to minimize the generated heat that can cause failure of bearings, sensors, or the motor.

Patents

NASA Goddard Space Flight Center has patented this technology (U.S. Patent No. 5,723,923).

Licensing and Partnering Opportunities

This technology is part of NASA's Innovative Partnerships Program, which seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to consider licensing the Apparatus for Providing Torque and Storing Momentum Energy (GSC-13649-1) for commercial applications.

For More Information

If you are interested in more information or want to pursue transfer of this technology (GSC-13649-1), please contact:

**Office of Technology Transfer
NASA Goddard Space Flight Center
Reaction-Momentum-Wheel@gssc.nasa.gov**

More information about working with NASA Goddard's Office of Technology Transfer is available online:
<http://techtransfer.gsfc.nasa.gov>